

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20 through 39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year, and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7 percent between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry.

Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top chemicals (by weight) reported by each industry.

Definitions Associated with Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20 to 39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emission occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of

water. Any estimates for stormwater runoff and non-point losses must also be included.

Releases to Land -- includes disposal of toxic chemicals in waste to on-site landfills, land treated or incorporation into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatment works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or land filled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Petroleum Refining Industry

The amount of TRI chemicals generated by the petroleum refining industry provides a gross profile of the types and relative amounts of toxic chemical outputs from refining processes. Additional information, which can be related back to possible compliance requirements, is available from the distribution of chemical releases across specific media within the environment. The TRI data requires filers to list releases to air, water, and land separately. The distribution across media can also be compared to the profile of other industry sectors.

The petroleum refining industry releases 75 percent of its total TRI poundage to the air, 24 percent to the water (including 20 percent to underground injection and 4 percent to surface waters), and 1 percent to the land. This release profile differs from other TRI industries which average approximately 59 percent to air, 30 percent to water, and 10 percent to land. Examining the petroleum refining industry's TRI reported toxic chemical releases highlights the likely origins of the large air releases for the industry (Exhibit 16).

According to TRI data, in 1993 the petroleum refining industry released (discharged to the air, water, or land without treatment) and transferred (shipped off-site) a total of 482 million pounds of pollutants, made up of 103 different chemicals. This represents about 11 percent of the total pounds of TRI chemicals released and transferred by all manufacturers that year. In comparison, the chemical industry (SIC 28) produced 2.5 billion pounds that year, accounting for 33 percent of all releases and transfers.

Overall, the petroleum refining industry's releases declined between 1988 and 1993. Between 1991 and 1993 the decrease in releases was 6.7 percent compared to the average for all industries of 18 percent. In the same period, however, transfers were reported to increase 65 percent which is higher than the average increase in transfers of 25 percent for all manufacturing industries. A large portion of the increases were in the form of transfers to recycling. Spent sulfuric acid generated in the alkylation process makes up about half of all transfers of TRI listed chemicals off-site. At the facility level, the industry reported a level of pollution prevention activities of 42 percent of all refineries which is slightly higher than the overall average of about 35 percent of TRI reporting facilities.

Comparisons of the reported pounds released or transferred per facility demonstrate that the petroleum refining industry is far above average in its pollutant releases and transfers per facility when compared to other TRI industries. Of the twenty manufacturing SIC codes listed in the TRI

database, the mean amount of pollutant release per facility (including petroleum refining) was approximately 120,000 pounds. The TRI releases of the average petroleum refining facility (SIC 2911) were 404,000 pounds, making the industry 3.4 times higher in per facility releases than for other industries. For transfers, the mean of petroleum refining facilities was about 13 times as much that of all TRI manufacturing facilities (202,000 pounds transferred off-site per facility compared to 2,626,000 per refinery). These high releases and transfers per facility reflect the large volumes of material processed at a relatively small number of facilities.

Of the top ten most frequently reported toxic chemicals on the TRI list, the prevalence of volatile chemicals explains the air intensive toxic chemical loading of the refining industry. Nine of the ten most commonly reported toxic chemicals are highly volatile. Seven of the ten are aromatic hydrocarbons (benzene, toluene, ethylbenzene, xylene, cyclohexane, 1,2,4-trimethylbenzene and ethylbenze). Aromatic hydrocarbons are highly volatile compounds and make up a portion of both crude oil and many finished petroleum products. Ammonia, the ninth most commonly reported toxic chemical, is also released and transferred from petroleum refineries in large quantities. Ammonia may be found in high concentrations in process water streams from steam distillation processes and in refinery sour gas. The primary means of release to the environment is through underground injection of wastewater and emissions to air. Gasoline blending additives (i.e., methanol, ethanol, and MTBE) and chemical feedstocks (propylene, ethylene and naphthalene) are also commonly reported to TRI. Additives and chemical feedstocks are, for the most part, released as air emissions due to their high volatility. A significant portion of the remaining chemicals of the reported TRI toxic chemicals are metals compounds, which are typically transferred off-site for recovery or as a component of hazardous wastes. Although it is not the most frequently reported toxic chemical released or transferred, sulfuric acid is, by far, generated in the largest quantities. Spent sulfuric acid is primarily generated during the alkylation process. The acid is typically transferred off-site for regeneration.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below (Exhibit 19). Facilities that have reported only the SIC codes covered under this notebook appear on the first list. Exhibit 20 contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations -- some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 19: Top 10 TRI Releasing Petroleum Refineries ^b		
Rank	Facility	Total TRI Releases in Pounds
1	Amoco Oil Co. - Texas City, TX	13,196,734
2	Mobil Oil - Beaumont, TX	4,312,079
3	Chevron - Port Arthur, TX	2,513,247
4	BP Oil Co. Alliance Refinery - Belle Chasse, LA	1,992,942
5	Coastal Refining - Corpus Christi TX	1,827,682
6	Phillips P. R. Core Inc. - Guayama PR	1,806,163
7	Hess Oil St. Croix Refinery - Kingshill VI	1,720,814
8	Sun Refining & Marketing Co. - Tulsa, OK	1,555,245
9	Koch Refining Co. - Rosemount, MN	1,395,612
10	Koch Refining Co. - Corpus Christi TX	1,329,136
Source: U.S. EPA, Toxics Release Inventory Database, 1993.		

^b Being included in this list does not mean that the release is associated with non-compliance with environmental laws.

**Exhibit 20: Top 10 TRI Releasing Facilities Reporting Petroleum Refining
SIC Codes to TRI^c**

Rank	SIC Codes Reported in TRI	Facility	Total TRI Releases in Pounds
1	2911	Amoco Oil Co. Texas City Refinery - Texas City, TX	13,196,734
2	2911, 2869, 2865, 2821	Shell Oil Co., - Deer Park, TX	4,542,726
3	2911	Mobil Oil Beaumont Refinery - Beaumont, TX	4,312,079
4	2911	Chevron USA Products, Port Arthur Refinery - Port Arthur, TX	2,513,247
5	2911, 2869, 2992	Lyondell-Citgo Refining Co. Ltd. - Houston, TX	2,340,426
6	2911, 2819, 2869	Citgo Petroleum Corp. - Lake Charles, LA	2,116,136
7	2911	BP Oil Co. Alliance Refinery - Belle Chasse, LA	1,992,942
8	2911, 2869, 2873	Chevron Products Do. Pascagoula Refinery - Pascagoula, MS	1,922,457
9	2911	Coastal Refining & Marketing Inc. - Corpus Christi, TX	1,827,682
10	2911	Phillips P.R. Core Inc. Phillipa Paraxylene Inc. - Guayama, PR	1,806,163

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), the Hazardous Substances Data Bank (HSDB), and the Integrated Risk Information

^c Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

System (IRIS), both accessed via TOXNET^d. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB.

Ammonia (CAS: 7664-41-7)

Sources. Ammonia is formed from the nitrogen bearing components of crude oil and can be found throughout petroleum refineries in both the gaseous and aqueous forms. Gaseous ammonia often leaves distillation, cracking and treating processes mixed with the sour gas or acid gas along with refinery fuel gases and hydrogen sulfide. Aqueous ammonia is present in the sourwater generated in the vacuum distillation unit and steam strippers or fractionators. Some release sources include, fugitive emissions, sour gas stripper, sulfur unit and wastewater discharges.

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system.

Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters. Ammonia is a central compound

^d TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a corrosive and severely irritating gas with a pungent odor.

Toluene (CAS: 108-88-3)

Sources. Toluene is a component of crude oil and is therefore present in many refining operations. Toluene is also produced during catalytic reforming and is sold as one of the large volume aromatics used as feedstocks in chemical manufacturing. Its volatile nature makes fugitive emissions its largest release source. Point air sources may arise during the process of separating toluene from other aromatics and from solvent dewaxing operations where toluene is often used as the solvent..

Toxicity. Inhalation or ingestion of toluene can cause headaches, confusion, weakness, and memory loss. Toluene may also affect the way the kidneys and liver function.

Reactions of toluene (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Some studies have shown that unborn animals were harmed when high levels of toluene were inhaled by their mothers, although the same effects were not seen when the mothers were fed large quantities of toluene. Note that these results may reflect similar difficulties in humans.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. A portion of releases of toluene to land and water will evaporate. Toluene may also be degraded by microorganisms. Once volatilized, toluene in the lower atmosphere will react with other atmospheric components contributing to the formation of ground-level ozone and other air pollutants.

Physical Properties. Toluene is a volatile organic chemical.

Xylenes (Mixed Isomers) (CAS: 1330-20-7)

Sources. Xylene isomers are a component of crude oil and are therefore present in many refining operations. Xylenes are also produced during catalytic reforming and are sold as one of the large volume aromatics used as feedstocks in chemical manufacturing. Xylene's volatile nature makes fugitive emissions the largest release source. Point air sources may arise during the process of separating xylene from other aromatics.

Toxicity. Xylenes are rapidly absorbed into the body after inhalation, ingestion, or skin contact. Short-term exposure of humans to high levels of xylene can cause irritation of the skin, eyes, nose, and throat, difficulty in breathing, impaired lung function, impaired memory, and possible changes in the liver and kidneys. Both short- and long-term exposure to high concentrations can cause effects such as headaches, dizziness, confusion, and lack of muscle coordination. Reactions of xylene (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. A portion of releases to land and water will quickly evaporate, although some degradation by microorganisms will occur.

Xylenes are moderately mobile in soils and may leach into groundwater, where they may persist for several years.

Xylenes are volatile organic chemicals. As such, xylene in the lower atmosphere will react with other atmospheric components, contributing to the formation of ground-level ozone and other air pollutants.

Methyl Ethyl Ketone (CAS: 78-93-3)

Sources. Methyl ethyl ketone (MEK) is used in some refineries as a solvent in lube oil dewaxing. Its extremely volatile characteristic makes fugitive emissions its primary source of releases to the environment.

Toxicity. Breathing moderate amounts of methyl ethyl ketone (MEK) for short periods of time can cause adverse effects on the nervous system ranging from headaches, dizziness, nausea, and numbness in the fingers and toes to unconsciousness. Its vapors are irritating to the skin, eyes,

nose, and throat and can damage the eyes. Repeated exposure to moderate to high amounts may cause liver and kidney effects.

Carcinogenicity. No agreement exists over the carcinogenicity of MEK. One source believes MEK is a possible carcinogen in humans based on limited animal evidence. Other sources believe that there is insufficient evidence to make any statements about possible carcinogenicity.

Environmental Fate. Most of the MEK released to the environment will end up in the atmosphere. MEK can contribute to the formation of air pollutants in the lower atmosphere. It can be degraded by microorganisms living in water and soil.

Physical Properties. Methyl ethyl ketone is a flammable liquid.

Propylene (CAS: 115-07-1)

Sources. Propylene (propene) is one of the light ends formed during catalytic and thermal cracking and coking operations. It is usually collected and used as a feedstock to the alkylation unit. Propylene is volatile and soluble in water making releases to both air and water significant.

Toxicity. At low concentrations, inhalation of propylene causes mild intoxication, a tingling sensation, and an inability to concentrate. At higher concentrations, unconsciousness, vomiting, severe vertigo, reduced blood pressure, and disordered heart rhythms may occur. Skin or eye contact with propylene causes freezing burns.

Reaction of propylene (see environmental fate) in the atmosphere contributes to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Ecologically, similar to ethylene, propylene has a stimulating effect on plant growth at low concentrations, but inhibits plant growth at high levels.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Propylene is degraded principally by hydroxyl ions in the atmosphere. Propylene released to soil and water is removed primarily through volatilization. Hydrolysis, bioconcentration, and soil adsorption are not expected to be significant fate processes of propylene

in soil or aquatic ecosystems. Propylene is readily biodegraded by microorganisms in surface water.

Physical Properties. Propylene is a volatile organic chemical.

Benzene (CAS: 71-43-2)

Sources. Benzene is a component of crude oil and is therefore present in many refining operations. Benzene is also produced during catalytic reforming and is sold as one of the large volume aromatics used as feedstocks in chemical manufacturing. Benzene's volatile nature makes fugitive emissions the largest release source. Point air sources may arise during the process of separating benzene from other aromatics.

Toxicity. Short-term inhalation of benzene primarily affects the central nervous system and respiratory system. Chronic exposure to benzene causes bone marrow toxicity in animals and humans, causing suppression of the immune system and development of leukemia. Ingestion of benzene is rare.

Reactions of benzene (see environmental fate) in the atmosphere contributes to the formation of ozone in the lower atmosphere (troposphere). Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Carcinogenicity. Benzene is a known human carcinogen, based on both oral and inhalation exposures.

Environmental Fate. A portion of benzene releases to soil and surface waters evaporate rapidly. Benzene is highly mobile in the soil and may leach to groundwater. Once in groundwater, it is likely biodegraded by microorganisms only in the presence of oxygen.

Benzene is not expected to significantly adsorb to sediments, bioconcentrate in aquatic organisms or break down in water. Atmospheric benzene is broken down through reacting with chemical ions in the air; this process is greatly accelerated in the presence of other air pollutants such as nitrogen oxides or sulfur dioxide. Benzene is fairly soluble in water and is removed from the atmosphere in rain.

As a volatile chemical, benzene in the lower atmosphere will react with other atmospheric components, contributing to the formation of ground-level ozone and other air pollutants, which can contribute to respiratory

illnesses in both the general and highly susceptible populations, such as asthmatics and allergy-sufferers.

IV.C. Other Data Sources

In addition to chemicals covered under TRI, many other chemicals are released. For example, the EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., VOCs, SO_x, NO_x, CO, particulates, etc.) from many refinery sources.⁷⁷

The EPA Office of Air's Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 18 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO₂), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO₂), and volatile organic compounds (VOCs).

Exhibit 21: Pollutant Releases (short tons/year)						
Industry Sector	CO	NO₂	PM₁₀	PT	SO₂	VOC
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Production	123,756	42,658	14,135	63,761	9,419	41,423
Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	541,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	103,575	4,107	39,062	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,155	369,058
Rubber and Misc. Plastics	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Computer and Office Equipment	24	0	0	0	0	0
Electronics and Other Electrical Equipment and Components	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

Source: U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Exhibit 22 is a graphical representation of a summary of the 1993 TRI data for the petroleum refining industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 23 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of petroleum refining, the 1993 TRI data presented here covers 159 facilities. These facilities listed SIC 2911 (petroleum refining) as a primary SIC code.

SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333,334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the petroleum refining industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can be, or are being, implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

Drivers and Barriers to Pollution Prevention in the Petroleum Refining Industry

Pollution prevention in the petroleum refining industry is expected to become increasingly important as federal, state and municipal regulations become more stringent and as waste disposal costs rise. According to the American Petroleum Institute, the industry currently spends a significant amount of money every year on environmental quality and protection⁷⁸. This provides the industry with a strong incentive to find ways to reduce the generation of waste and to lessen the burden of environmental compliance investments. For the petroleum refining industry, pollution prevention will primarily be realized through improved operating procedures, increased recycling, and process modifications.

A cooperative effort of the Amoco Corporation and EPA to study pollution prevention at an operating oil refinery identified a number of cost effective pollution prevention techniques for the refinery that could also be adopted

by other refineries. In addition, the American Petroleum Institute (API) has assembled a compendium of waste minimization practices for the petroleum industry based on a survey of its members. Brief descriptions of some of the more widespread pollution prevention techniques found to be effective at petroleum refineries are provided below. For more detail on the pollution prevention options listed below and for descriptions of facility- and process- specific options refer to the above mentioned documents and other pollution prevention/waste minimization documents listed in Section IX - Resource Materials.

Although numerous cases have been documented where petroleum refineries have simultaneously reduced pollution outputs and operating costs through pollution prevention techniques, there are often barriers to their implementation. The primary barrier to most pollution prevention projects is cost. Many pollution prevention options simply do not pay for themselves. Corporate investments typically must earn an adequate return on invested capital for the shareholders and some pollution prevention options at some facilities may not meet the requirements set by the companies. In addition, the equipment used in the petroleum refining industry are very capital intensive and have very long lifetimes. This reduces the incentive to make process modifications to (expensive) installed equipment that is still useful. It should be noted that pollution prevention techniques are, nevertheless, often more cost-effective than pollution reduction through end-of-pipe treatment. A case study based on the Amoco/EPA joint study claimed that the same pollution reduction currently realized through end-of-pipe regulatory requirements at the Amoco facility could be achieved at 15 percent the current costs using pollution prevention techniques.

A number of regulatory disincentives to voluntary reductions of emissions from petroleum refineries also exist. Many environmental statutes define a baseline period and measure progress in pollution reductions from that baseline. Any reduction in emissions before it is required could lower a facility's baseline emissions. Consequently, future regulations requiring a specified reduction from the baseline could be more costly to achieve because the most cost-effective reductions would already have been made. With no credit given for voluntary reductions, those facilities that do the minimum may be in fact be rewarded when emissions reductions are required.

The 1990 Clean Air Act Amendments aimed to encourage voluntary reductions above the regulatory requirements by allowing facilities to obtain emission credits for voluntary reductions in emissions. These credits would serve as offsets against any potential future facility modifications resulting in an increase in emissions. Other regulations

established by the amendments, however, will require the construction of major new units within existing refineries to produce reformulated fuels. These new operations will require emission offsets in order to be permitted. This will consume many of the credits available for existing facility modifications. A shortage of credits for facility modifications will make it difficult to receive credits for emission reductions through pollution prevention projects.

Under the Clean Water Act, discharge of water-borne pollutants is limited by NPDES permits. Refineries that easily meet their permit requirements will often have their permit limits changed to lower values. Because occasional system upsets do occur resulting in significant excursions above the normal performance values, refineries feel they must maintain a large operating margin below the permit limits to ensure continuous compliance. Those refineries that can significantly reduce water-borne emissions through pollution prevention techniques may find the risk of having their permit limits lowered to be a substantial disincentive.

Wastes failing a Toxicity Characteristic (TC) test are considered hazardous under RCRA. There is less incentive for a refinery to attempt to reduce the toxicity of such waste below the TC levels because, even though such toxicity reductions may render the waste non-hazardous, it may still have to comply with new Land Disposal treatment standards under subtitle C of RCRA before being land disposed. Similarly, there is little positive incentive to reduce the toxicity of listed refinery hazardous wastes because, once listed, the waste is subject to subtitle C regulations without regard to how much the toxicity levels are reduced.

Examples of Process or Equipment Modifications Options

Place secondary seals on storage tanks - One of the largest sources of fugitive emissions from refineries is storage tanks containing gasoline and other volatile products. These losses can be significantly reduced by installing secondary seals on storage tanks. The Amoco/EPA joint study estimated that VOC losses from storage tanks could be reduced 75 to 93 percent. Equipping an average tank with a secondary seal system was estimated to cost about \$20,000.

Establish leak detection and repair program - Fugitive emissions are one of the largest sources of refinery hydrocarbon emissions. A leak detection and repair (LDAR) program consists of using a portable VOC detecting instrument to detect leaks during regularly scheduled inspections of valves, flanges, and pump seals. Leaks are then repaired immediately or are scheduled for repair as quickly as possible. A LDAR program could

reduce fugitive emissions 40 to 64 percent, depending on the frequency of inspections.⁷⁹

Regenerate or eliminate filtration clay - Clay from refinery filters must periodically be replaced. Spent clay often contains significant amounts of entrained hydrocarbons and, therefore, must be designated as hazardous waste. Back washing spent clay with water or steam can reduce the hydrocarbon content to levels so that it can be reused or handled as a nonhazardous waste. Another method used to regenerate clay is to wash the clay with naphtha, dry it by steam heating and then feed it to a burning kiln for regeneration. In some cases clay filtration can be replaced entirely with hydrotreating.

Reduce the generation of tank bottoms - Tank bottoms from crude oil storage tanks constitute a large percentage of refinery solid waste and pose a particularly difficult disposal problem due to the presence of heavy metals. Tank bottoms are comprised of heavy hydrocarbons, solids, water, rust and scale. Minimization of tank bottoms is carried out most cost effectively through careful separation of the oil and water remaining in the tank bottom. Filters and centrifuges can also be used to recover the oil for recycling.

Minimize solids leaving the desalter - Solids entering the crude distillation unit are likely to eventually attract more oil and produce additional emulsions and sludges. The amount of solids removed from the desalting unit should, therefore, be maximized. A number of techniques can be used such as: using low shear mixing devices to mix desalter wash water and crude oil; using lower pressure water in the desalter to avoid turbulence; and replacing the water jets used in some refineries with mud rakes which add less turbulence when removing settled solids.

Minimize cooling tower blowdown - The dissolved solids concentration in the recirculating cooling water is controlled by purging or blowing down a portion of the cooling water stream to the wastewater treatment system. Solids in the blowdown eventually create additional sludge in the wastewater treatment plant. However, the amount of cooling tower blowdown can be lowered by minimizing the dissolved solids content of the cooling water. A significant portion of the total dissolved solids in the cooling water can originate in the cooling water makeup stream in the form of naturally occurring calcium carbonates. Such solids can be controlled either by selecting a source of cooling tower makeup water with less dissolved solids or by removing the dissolved solids from the makeup water stream. Common treatment methods include: cold lime softening, reverse osmosis, or electrodialysis.

Install vapor recovery for barge loading - Although barge loading is not a factor for all refineries, it is an important emissions source for many facilities. One of the largest sources of VOC emissions identified during the Amoco/EPA study was fugitive emissions from loading of tanker barges. It was estimated that these emissions could be reduced 98 percent by installing a marine vapor loss control system. Such systems could consist of vapor recovery or VOC destruction in a flare.

Minimize FCCU decant oil sludge - Decant oil sludge from the fluidized bed catalytic cracking unit (FCCU) can contain significant concentrations of catalyst fines. These fines often prevent the use of decant oil as a feedstock or require treatment which generates an oily catalyst sludge. Catalysts in the decant oil can be minimized by using a decant oil catalyst removal system. One system incorporates high voltage electric fields to polarize and capture catalyst particles in the oil. The amount of catalyst fines reaching the decant oil can be minimized by installing high efficiency cyclones in the reactor to shift catalyst fines losses from the decant oil to the regenerator where they can be collected in the electrostatic precipitator.

Control of heat exchanger cleaning solids - In many refineries, using high pressure water to clean heat exchanger bundles generates and releases water and entrained solids to the refinery wastewater treatment system. Exchanger solids may then attract oil as they move through the sewer system and may also produce finer solids and stabilized emulsions that are more difficult to remove. Solids can be removed at the heat exchanger cleaning pad by installing concrete overflow weirs around the surface drains or by covering drains with a screen. Other ways to reduce solids generation are by using anti-foulants on the heat exchanger bundles to prevent scaling and by cleaning with reusable cleaning chemicals that also allow for the easy removal of oil.

Control of surfactants in wastewater - Surfactants entering the refinery wastewater streams will increase the amount of emulsions and sludges generated. Surfactants can enter the system from a number of sources including: washing unit pads with detergents; treating gasolines with an end point over 400 degrees (F) thereby producing spent caustics; cleaning tank truck tank interiors; and using soaps and cleaners for miscellaneous tasks. In addition, the overuse and mixing of the organic polymers used to separate oil, water and solids in the wastewater treatment plant can actually stabilize emulsions. The use of surfactants should be minimized by educating operators, routing surfactant sources to a point downstream of the DAF unit and by using dry cleaning, high pressure water or steam to clean oil surfaces of oil and dirt.

Thermal treatment of applicable sludges - The toxicity and volume of some deoiled and dewatered sludges can be further reduced through thermal treatment. Thermal sludge treatment units use heat to vaporize the water and volatile components in the feed and leave behind a dry solid residue. The vapors are condensed for separation into the hydrocarbon and water components. Non-condensable vapors are either flared or sent to the refinery amine unit for treatment and use as refinery fuel gas.

Eliminate use of open ponds - Open ponds used to cool, settle out solids and store process water can be a significant source of VOC emissions. Wastewater from coke cooling and coke VOC removal is occasionally cooled in open ponds where VOCs easily escape to the atmosphere. In many cases, open ponds can be replaced with closed storage tanks.

Remove unnecessary storage tanks from service - Since storage tanks are one of the largest sources of VOC emissions, a reduction in the number of these tanks can have a significant impact. The need for certain tanks can often be eliminated through improved production planning and more continuous operations. By minimizing the number of storage tanks, tank bottom solids and decanted wastewater may also be reduced.

Replace old boilers - Older refinery boilers can be a significant source of SO_x, NO_x and particulate emissions. It is possible to replace a large number of old boilers with a single new cogeneration plant with emissions controls.

Modify the FCCU to allow the use of catalyst fines - Some FCCUs can be modified to recycle some of the catalyst fines generated.

Reduce the use of 55-gallon drums - Replacing 55-gallon drums with bulk storage can minimize the chances of leaks and spills.

Install rupture discs and plugs - Rupture discs on pressure relieve valves and plugs in open ended valves can reduce fugitive emissions.

Install high pressure power washer - Chlorinated solvent vapor degreasers can be replaced with high pressure power washers which do not generate spent solvent hazardous wastes.

Refurbish or eliminate underground piping - Underground piping can be a source of undetected releases to the soil and groundwater. Inspecting, repairing or replacing underground piping with surface piping can reduce or eliminate these potential sources.

Examples of Potential Waste Segregation and Separation Options

Segregate process waste streams - A significant portion of refinery waste arises from oily sludges found in combined process/storm sewers. Segregation of the relatively clean rainwater runoff from the process streams can reduce the quantity of oily sludges generated. Furthermore, there is a much higher potential for recovery of oil from smaller, more concentrated process streams.

Control solids entering sewers - Solids released to the wastewater sewer system can account for a large portion of a refinery's oily sludges. Solids entering the sewer system (primarily soil particles) become coated with oil and are deposited as oily sludges in the API oil/water separator. Because a typical sludge has a solids content of 5 to 30 percent by weight, preventing one pound of solids from entering the sewer system can eliminate 3 to 20 pounds of oily sludge. The Amoco/EPA study estimated that at the Yorktown facility 1,000 tons of solids per year enter the refinery sewer system. Methods used to control solids include: using a street sweeper on paved areas, paving unpaved areas, planting ground cover on unpaved areas, re-lining sewers, cleaning solids from ditches and catch basins, and reducing heat exchanger bundle cleaning solids by using antifoulants in cooling water.

Improve recovery of oils from oily sludges - Because oily sludges make up a large portion of refinery solid wastes, any improvement in the recovery of oil from the sludges can significantly reduce the volume of waste. There are a number of technologies currently in use to mechanically separate oil, water and solids, including: belt filter presses, recessed chamber pressure filters, rotary vacuum filters, scroll centrifuges, disc centrifuges, shakers, thermal driers and centrifuge-drier combinations.

Identify benzene sources and install upstream water treatment - Benzene in wastewater can often be treated more easily and effectively at the point it is generated rather than at the wastewater treatment plant after it is mixed with other wastewater.

Examples of Recycling Options

Recycle and regenerate spent caustics - Caustics used to absorb and remove hydrogen sulfide and phenol contaminants from intermediate and final product streams can often be recycled. Spent caustics may be saleable to chemical recovery companies if concentrations of phenol or hydrogen sulfide are high enough. Process changes in the refinery may be needed to raise the concentration of phenols in the caustic to make recovery of the contaminants economical. Caustics containing phenols can

also be recycled on-site by reducing the pH of the caustic until the phenols become insoluble thereby allowing physical separation. The caustic can then be treated in the refinery wastewater system.

Use oily sludges as feedstock - Many oily sludges can be sent to a coking unit or the crude distillation unit where it becomes part of the refinery products. Sludge sent to the coker can be injected into the coke drum with the quench water, injected directly into the delayed coker, or injected into the coker blowdown contactor used in separating the quenching products. Use of sludge as a feedstock has increased significantly in recent years and is currently carried out by most refineries. The quantity of sludge that can be sent to the coker is restricted by coke quality specifications which may limit the amount of sludge solids in the coke. Coking operations can be upgraded, however, to increase the amount of sludge that they can handle.

Control and reuse FCCU and coke fines - Significant quantities of catalyst fines are often present around the FCCU catalyst hoppers and reactor and regeneration vessels. Coke fines are often present around the coker unit and coke storage areas. The fines can be collected and recycled before being washed to the sewers or migrating off-site via the wind. Collection techniques include dry sweeping the catalyst and coke fines and sending the solids to be recycled or disposed of as non-hazardous waste. Coke fines can also be recycled for fuel use. Another collection technique involves the use of vacuum ducts in dusty areas (and vacuum hoses for manual collection) which run to a small baghouse for collection.

Recycle lab samples - Lab samples can be recycled to the oil recovery system.

Examples of Training and Supervision

Train personnel to reduce solids in sewers - A facility training program which emphasizes the importance of keeping solids out of the sewer systems will help reduce that portion of wastewater treatment plant sludge arising from the everyday activities of refinery personnel.

Train personnel to prevent soil contamination - Contaminated soil can be reduced by educating personnel on how to avoid leaks and spills.

Examples of Potential Material Substitution

Use non-hazardous degreasers - Spent conventional degreaser solvents can be reduced or eliminated through substitution with less toxic and/or biodegradable products.

Eliminate chromates as an anti-corrosive - Chromate containing wastes can be reduced or eliminated in cooling tower and heat exchanger sludges by replacing chromates with less toxic alternatives such as phosphates.

Use high quality catalysts - By using catalysts of a higher quality, process efficiencies can be increased while the required frequency of catalyst replacement can be reduced.

Replace ceramic catalyst support with activated alumina supports - Activated alumina supports can be recycled with spent alumina catalyst.

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A contains a general overview of major statutes
- Section VI.B contains a list of regulations specific to this industry
- Section VI.C contains a list of pending and proposed regulations

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation and Recovery Act (RCRA)

The Resource Conservation And Recovery Act (RCRA) of 1976, which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's hazardous waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") and materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the

permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264, Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.
- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and record keeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.
- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR Part 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.
- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards.

For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.
- **Underground Storage Tanks (USTs)** containing petroleum and CERCLA hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.
- **Boilers and Industrial Furnaces (BIFs)** that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act (CERCLA)

CERCLA, a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may present an imminent and substantial endangerment to public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR §302.4. A release report may trigger a response by EPA or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1,300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act (EPCRA)

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created EPCRA, also known as SARA Title III, a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a non-exempt release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.
- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold of chemical use to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.
- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Clean Water Act (CWA)

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the CWA, is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges

or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Stormwater discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying stormwater and which is directly related to manufacturing, processing or raw material storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges

from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-

furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the toxicity characteristics of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed general pretreatment standards and technology-based standards for industrial users of POTWs in many industrial categories. Different standards may apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act (SDWA)

The SDWA mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act (TSCA)

TSCA granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA

provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET, excluding Federal holidays.

Clean Air Act (CAA)

The CAA and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet

NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards are being developed for both new and existing sources based on "maximum achievable control technology (MACT)." The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created an operating permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restricting their use and

distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Requirements

The petroleum refining industry is unique in that the environmental requirements aimed at the industry are of two basic types: (1) requirements mandating specific product qualities for the purpose of reducing the environmental impacts associated with the downstream use of the product; and (2) requirements directed at reducing the environmental impacts of the refineries themselves. Presently, some of the most significant environmental statutes affecting refineries economically are geared toward altering the product formulation with the aim of reducing pollutant releases from use of the finished products (primarily fuels). Since 1970, various product quality regulations have been promulgated affecting specific formulations of gasoline and other fuels. These formulations often require significant process changes and capital investments at petroleum refineries. Environmental requirements aimed at reducing the pollution outputs from refinery operations themselves also require significant investments to change the processes and equipment. These requirements aimed at reformulating refinery products and reducing emissions from refinery operations make petroleum refining one of the most heavily regulated industries.

Clean Air Act of 1970 (CAA)

Of the various environmental statutes affecting the industry, the CAA of 1970 and the CAAA of 1990 have had, and will continue to have, the most significant impact on the petroleum refining industry.

The 1970 CAA authorized EPA to establish, in 1971, the National Ambient Air Quality Standards (NAAQS) which set standards for sulfur dioxide, nitrous oxides, carbon monoxide, ozone, non-methane

hydrocarbons, opacity and total suspended particulates in the ambient air. The Act also established a schedule for the reduction and eventual elimination of lead in gasoline. In 1978, a national ambient air standard for lead was established. More complex refining techniques such as incorporating more downstream conversion units, catalytic processes, octane boosting additives, and lubricating additives, were developed to make up for the properties lost as a result of reducing lead anti-knock additives. Another provision of the Act limited the sulfur content in residual and distillate fuel oils used by electric utilities and industrial plants. To meet the demand for low-sulfur fuels, desulfurization processing units were developed.⁸⁰

Clean Air Act Amendments of 1990 (CAAA)

Despite a major reduction in automobile emissions after the 1970 CAA, many areas of the U.S. were not in compliance with the NAAQS. These areas, termed "nonattainment areas," became an important subject of the 1990 amendments to the 1970 CAA. The CAAA of 1990 provide much more stringent requirements than the original CAA. The Act is organized into nine titles: Urban Air Quality, Mobile Sources, Toxic Air Pollutants, Acid Rain Control, Permits, Stratospheric Ozone Depletion, Enforcement, General Provisions, and Research. The major requirements altering product formulations to reduce emissions from mobile sources are contained in four programs: the Oxygenated Fuels Program, the Highway Diesel Fuel Program, the Reformulated Fuels Program, and the Leaded Gasoline Removal Program. Additional programs aimed at reducing air emissions from the refineries themselves and which have significant impacts on refineries include: New Source Review (NSR), New Source Performance Standards (NSPS), and National Emission Standards for Hazardous Air Pollutants (NESHAP).⁸¹

Oxygenated Fuels Program

The Oxygenated Fuels Program required that by November 1992, all gasoline sold in the 39 carbon monoxide nonattainment areas must have a minimum of 2.7 percent oxygen (by weight) for at least four winter months. The higher oxygen content lowers the levels of carbon monoxide produced during combustion. In California's carbon monoxide nonattainment areas, the winter fuel oxygen content is set at 1.8 to 2.2 percent because it is expected that higher oxygen levels increase nitrogen oxide emissions to unacceptable levels (for which the area is also in nonattainment).

In response to the program, the domestic capacity to produce oxygenates for oxygenated fuels has increased 59 percent from 1991 to 1993. This

required significant investments in oxygenate production facilities at both refineries and at nonrefinery stand-alone facilities that produce ethanol from grain, methyl tertiary butyl ether (MTBE) from oil field butane streams, and methanol from natural gas.⁸² The mandatory use of ethanol as an oxygenate, however, was overturned by a court in May of 1995.

Highway Diesel Fuel Program

The Highway Diesel Fuel Program required that the sulfur content of all highway diesel fuel be reduced from 0.5 percent to 0.05 percent (by weight) by October 1, 1993. Small refineries (below 18,250 thousand barrels of crude oil throughput per year) were given the option of using tradeable credits on sulfur reduction as a means of compliance until December 31, 1999. The program also requires that the cetane index, which measures the self-ignition quality of diesel fuel, must be maintained at a minimum of 40.

Increased construction of desulfurization downstream units, such as catalytic hydrocracking and hydrotreating units is underway to comply with these new requirements. Small refineries not wanting to invest in new downstream units may have the option of producing only distillate fuel oil for non-highway use. Diesel fuel and distillate fuel oils can be interchanged; however, as of October 1, 1993, distillate fuel oil and diesel fuel with high sulfur content were marked with a dye to prevent sale for highway use. Industry estimates a capital cost of \$3.3 billion to comply with the Highway Diesel Fuel Program.⁸³

Reformulated Fuels Program

The Reformulated Fuels Program, or Reformulated Gasoline (RFG) Program, requires the use of reformulated gasoline by January 1, 1995 in nine U.S. metropolitan areas (more than 250,000 people) with the worst ground level ozone problems. Other nonattainment areas can "opt in" to the program as a way of reducing ozone levels. EPA can delay a request to opt-in for up to three years if the supply of reformulated gasoline is not large enough. Such reformulated gasoline must have a minimum oxygen content of two percent by weight, a maximum benzene content of one percent by volume, and no lead or manganese. In addition, the year round average of nitrogen oxide emissions may not exceed that of a 1990 summertime baseline gasoline; the 1990 baseline tailpipe emissions of volatile organic compounds and toxic air pollutants (TAPs) must be reduced by 15 percent; and benzene must be below 1 percent. By 1998, a new "complex" formula for reformulated gasoline will replace the

original "simple" formula. By 2000, TAPs emissions are to be reduced by at least 20 percent, VOC emissions reduced by at least 25 percent, and NO_x emissions reduced by at least 5 percent in the summertime.⁸⁴

Of the four highway fuels programs, complying with the reformulated gasoline rules will require the largest process changes. Gasoline formulation will need to be upgraded to reduce the aromatic and VOC emissions from motor vehicles. The catalytic reforming process is expected to be used less, thereby lowering the levels of benzene and other aromatics produced. Hydrotreating units will be utilized more in order to meet the lower sulfur specifications. It is uncertain how many nonattainment areas will eventually opt-in to the program, which could have a significant effect on the capacity needs for the various downstream processes. As of June 1995, 18 areas have opted-in.

Leaded Gasoline Removal Program

The fourth program to limit emissions from mobile sources prohibits the sale of leaded gasoline for use in motor vehicles after 1995. The CAA 1970 has already reduced lead content substantially and the elimination of leaded gas is not expected to create significant changes in the industry.⁸⁵

Reid Vapor Pressure Regulations of 1989 and 1992

The Reid Vapor Pressure (RVP) regulations were implemented by the EPA to reduce emissions of VOCs and other ozone precursors. The regulations set standards for the volatility of summertime motor gasoline in some U.S. urban areas. The program was implemented in two phases with the first beginning in the spring of 1989 and the second in 1992. The Phase I summer volatility standards limited the average Reid Vapor Pressure (a measure of the volatility of motor gasoline) to a maximum of 10.5 psi and 9.0 psi in certain areas of the country. The Phase II summer volatility standards set a nationwide maximum RVP of 9.0 psi and, in some ozone nonattainment cities in the south, the standard was set at 7.8 psi. Phase II will stay in effect through the summer of 1994 in the nine RFG areas. In 1995, the VOC standards of the 1990 CAAA Reformulated Gasoline Program will take the place of the RVP regulations.

The Phase I standards were met by reducing the amount of butane blended into gasoline. In addition to having a high RVP, butane is also high octane. To compensate for the resulting loss in octane and volume both crude oil inputs and the use of catalytic cracking and alkylation units have increased. The Phase II standards were met by increasing downstream processing and the blending with high-octane, lower RVP components.

To meet the RVP regulations, large capital investments were made in facilities to produce these blending components.⁸⁶

New Source Review and New Source Performance Standards

The 1990 CAA New Source Review (NSR) requirements apply to new facilities, expansions of existing facilities, or process modifications. New sources of the NAAQS "criteria" pollutants in excess of "major" levels defined by EPA are subject to NSR requirements (40 CFR §52.21(b)(1)(i)(a)-(b)). NSRs are typically conducted by the state agency under standards set by EPA and adopted by the state as part of its state implementation plan (SIP). There are two types of NSRs: Prevention of Significant Deterioration (PSD) reviews for those areas that are meeting the NAAQS; and nonattainment (NA) reviews for areas that are violating the NAAQS. Permits are required to construct or operate the new source for PSD and NA areas. For NA areas, permits require the new source to meet lowest achievable emission rate (LAER) standards and the operator of the new source must procure reductions in emissions of the same pollutants from other sources in the NA area in equal or greater amounts to the new source. These "emission offsets" may be banked and traded through state agencies. For PSD areas, permits require the best available control technology (BACT), and the operator or owner of the new source must conduct continuous on-site air quality monitoring for one year prior to the new source addition to determine the effects that the new emissions may have on air quality. EPA sets the minimum standards for LAER and BACT for petroleum refinery NSRs in its new source performance standards (NSPS), 40 CFR Part 60:

Subpart J	Standards of Performance for Petroleum Refineries
Subpart K,K,K	Standards of Performance for Volatile Organic Liquid Storage Vessels
Subpart GG	Standards of Performance for Stationary Gas Turbines
Subpart GGG	Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries
Subpart NNN	Standards of Performance for VOC Emissions from SOCFI Distillation Operations (manufacturing of organic chemicals e.g., MTBE)
Subpart QQQ	Standards of Performance for VOC Emissions from Petroleum Wastewater Systems ^{87,88}

National Emission Standards for Hazardous Air Pollutants (NESHAP)

Under Title III of the 1990 CAAA, EPA is required to develop national emission standards for 189 hazardous air pollutants (NESHAP) including benzene and approximately 20 other chemicals typically emitted at petroleum refineries. The development of the NESHAP regulations are taking place in two phases. In the first phase, EPA is developing maximum achievable control technology (MACT) standards for all new and existing sources (James Durham, U.S. EPA, Office of Air, (919) 541-5672). EPA can give a six year extension of NESHAP requirements in exchange for an enforceable commitment to an early reduction of emissions by 90 percent. At the time this document went to print EPA estimated that the MACT standards for petroleum refineries would be finalized by the end of July 1995. The second phase of the NESHAP regulations is to be implemented in 2000 and requires assessing whether or not remaining risk after the MACT standards have been implemented is acceptable.⁸⁹ For petroleum refineries, the following NESHAPs apply, 40 CFR Part 61:

- Subpart J National Emission Standards for Equipment Leaks of Benzene
- Subpart M National Emission Standards for Asbestos (Demolition and Renovation)
- Subpart V National Emission Standards for Equipment Leaks (Fugitive Emission Sources)
- Subpart Y National Emission Standards for Benzene Emissions from Benzene Storage Tanks
- Subpart BB National Emission Standards for Benzene Emissions from Benzene Transfer Operations
- Subpart FF National Emission Standards for Benzene Waste Operations

In addition, Subpart E (National Emission Standards for Mercury) will apply if the refinery has a wastewater treatment plant sludge incinerator.⁹⁰

Resource Conservation and Recovery Act (RCRA)

RCRA gives EPA the authority to establish a list of solid and hazardous wastes, and to establish standards and regulations for handling and disposing of these wastes. Although the costs of complying with RCRA

requirements may not be as great as that of the 1990 CAAA, there are significant capital and operational costs as well as administrative costs related to permitting, technical studies and analytical requirements.

The majority of solid wastes generated at refineries are non-hazardous residuals. Most of these wastes are typically recycled within the refinery or are landfilled or incinerated onsite as non-hazardous wastes. Some of these wastes are sent off-site for treatment, land disposal or land treatment (land farming). A number of wastes commonly generated at refineries, however, are hazardous under RCRA. The largest number of different RCRA hazardous wastes are generated during wastewater treatment prior to discharge. These could include: API separator sludge (K051); slop oil emulsion solids (K049); other primary oil-water separator sludge, barscreen debris (F037); characteristic wastes containing chromium (D007) or lead (D008); dissolved air flotation floats (K048); and all other sludge, floats and used filter bags (F038). Other potential refinery wastes regulated under RCRA include those generated from cleaning of heat exchanger bundles (K050), desalter mud (F037), laboratory wastes (F003, F005, D001, etc.), spent alkylation sulfuric acid (D002; except when used to produce virgin sulfuric acid, 40 CFR §261.4(a)(7)) and leaded tank bottom corrosion solids (K052), waste paint materials (D001), and wastes containing benzene (D018).⁹¹ Spent process catalysts are occasionally RCRA characteristic hazardous wastes for reactivity due to benzene (D018) or for toxicity due to sulfur on the catalyst surface (D003).⁹²

Some of the handling and treating requirements for RCRA hazardous wastes generators are covered under 40 CFR Part 262 and involve: determining what constitutes a RCRA hazardous waste (Subpart A); manifesting (Subpart B); packaging, labeling and accumulation time limits (Subpart C); and record keeping and reporting (Subpart D).⁹³

Many refineries store some hazardous wastes at the facility for more than 90 days and, therefore, are a storage facility under RCRA and must have a RCRA treatment, storage and disposal facility (TSDF) permit (40 CFR §262.34). Some of the specific requirements that may apply to refineries that are TSD facilities are covered under 40 CFR Part 264, and include: contingency plans and emergency procedures (40 CFR Part 264 Subpart D); manifesting, record keeping and reporting (Subpart E); use and management of containers (Subpart I); tank systems (Subpart J); surface impoundments (Subpart K); land treatment (Subpart M); incinerators (Subpart O), although few refineries incinerate hazardous wastes onsite; corrective action of hazardous waste releases (Subpart S); air emissions standards for process vents of processes that process or generate hazardous wastes (Subpart AA); emissions standards for leaks in hazardous waste handling equipment (Subpart BB); and emissions standards for containers,

tanks, and surface impoundments that contain hazardous wastes (Subpart CC).

The 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA require that any area at a facility where solid wastes have been routinely and systematically released at a treatment, storage, or disposal facility are required to carry out “corrective actions.” Corrective action requirements are decided by EPA or the states on a facility-by-facility basis and can extend to remediation beyond the facility boundary. Since most refineries have filed for RCRA permits and because it is common for refineries to have released wastes to the environment, it is expected that most refineries will eventually undergo a RCRA corrective action. The costs of remediating contamination that has occurred over the life of a refinery could potentially be one of the most costly items facing a facility.⁹⁴

A number of RCRA wastes have been prohibited from land disposal unless treated to meet specific standards under the RCRA Land Disposal Restriction (LDR) program. The wastes covered by the RCRA LDRs are listed in 40 CFR Part 268, Subpart C and include a number of wastes commonly generated at petroleum refineries. Restrictions on common refinery wastes include toxicity characteristic wastes, which include those containing greater than 0.5 ppm benzene (D018) and sludges from refinery process wastewater treatment systems (F037). Restrictions on D018 wastes are expected to further reduce the amount of refinery wastes that are treated by landfarming off-site which has already been reduced significantly in recent years for both hazardous and non-hazardous wastes.⁹⁵ To meet the LDRs, these wastes are typically treated through incineration. In addition to the land disposal restrictions, standards for the treatment and storage of restricted wastes are also described in Subparts D and E, respectively.⁹⁶

Clean Water Act (CWA)

Petroleum refinery wastewater released to surface waters is regulated under the CWA. National Pollutant Discharge Elimination System (NPDES) permits must be obtained to discharge wastewater into navigable waters (40 Part 122). Effluent limitation guidelines for wastewater discharged from petroleum refineries were promulgated in 1985 and are currently being reviewed for updating in 1995 (Ronald Kirby, U.S. EPA Office of Water, (202)-260-7168). The effluent guidelines for the Petroleum Refining Point Source Category are listed under 40 CFR Part 419 and are divided into subparts according to the processes used by the refinery:

Subpart A	Applies to facilities using topping (distillation) and catalytic reforming
Subpart B	Applies to facilities using topping and cracking
Subpart C	Applies to facilities using topping, cracking and petrochemical operations
Subpart D	Applies to facilities using topping, cracking and lube oil manufacturing
Subpart E	Applies to facilities that use topping, cracking, lube oil manufacturing and petrochemical operations.

In addition to the effluent guidelines, facilities that discharge to a POTW may be required to meet National Pretreatment Standards for some contaminants. General pretreatment standards applying to most industries discharging to a POTW are described in 40 CFR Part 403. Pretreatment standards applying specifically to the Petroleum Refining Category are listed in the subparts of 40 CFR Part 419 (as shown above).⁹⁷

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing.

The recent storm water rules require certain facilities with storm water discharge from any one of 11 categories of industrial activity defined at 40 CFR 122.26 be subject to the storm water permit application requirements (see Section VI.A). Petroleum refineries are covered in Category ii by virtue of SIC code. The Storm Water Rule (40 CFR §122.26(b)(14) subparts (i, ii)) requires the capture and treatment of stormwater at all facilities falling under SIC code 291, including petroleum refineries. Required treatment of storm water flows are expected to remove a large fraction of both conventional pollutants, such as suspended solids and biological oxygen demand (BOD), as well as toxic pollutants, such as certain metals and organic compounds.⁹⁸

Safe Drinking Water Act (SDWA)

Those refineries that dispose of wastewater in underground injection wells are subject to the underground injection control (UIC) program of the Safe Drinking Water Act. The UIC program is aimed at protecting usable aquifers from contaminants migrating from injection wells. The program requires a permit for the placement of fluids into a well. Injection wells are also subject to substantive standards and criteria that may require a study of the potential of the well to contaminate the groundwater (40 CFR Parts 143-147). An injection well is classified in one of five categories (Class I-V) which reflect the relative risk of contaminating usable aquifers based on the proximity to drinking water supplies and the hydrogeological conditions in the area. Regulations vary for each well class. The UIC program is closely related to the RCRA program. Injection wells into which hazardous waste is injected constitute a land disposal facility under RCRA and, therefore, also require a RCRA permit. Under the RCRA regulations, injection wells with permits under the UIC program and which meet certain additional RCRA requirements, are considered to have a RCRA permit (40 CFR §270.60(b)).⁹⁹

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

Petroleum and crude oil are specifically exempt from listing in CERCLA. Wastes generated during the refining process and refined petroleum products containing CERCLA hazardous substances above specific levels are covered under CERCLA. Therefore, past releases of hazardous substances from a refinery are likely to require remedial clean-up actions under Superfund.¹⁰⁰

Emergency Planning and Community Right-to-Know Act (EPCRA)

Refineries are also covered by the reporting requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA). The

Community Right-to-Know provisions require that facilities with ten or more employees that manufactured, processed, or otherwise used a listed toxic chemical in excess of the "established threshold" must annually file a Toxic Chemical Release form with EPA and the state (EPCRA §313; 40 CFR Part 372). Facilities must submit material safety data sheets or the equivalent and Tier I/Tier II annual inventory report forms to the appropriate local emergency planning commission and emergency response and fire departments (EPCRA §§ 311-312; 40 CFR Part 370). Those handling "extremely hazardous substances" are also required to submit a one-time notice to the state emergency response commission (EPCRA §302(A); 40 CFR Part 355). Unintentional releases of a reportable quantity of a CERCLA hazardous substance or an extremely hazardous substance must be reported to the state emergency planning commission and the local emergency planning commission (40 CFR Part 304).¹⁰¹ Petroleum refineries are likely to use or produce a number of the chemicals listed, including ammonia, chlorine, hydrogen sulfide, methyl mercaptan, sulfur dioxide and sulfuric acid.

1990 Oil Pollution Act and Spill Prevention Control and Countermeasure Plans

The 1990 Oil Pollution Act establishes strict, joint and several liability against onshore and offshore facilities that discharge oil or pose a substantial threat of discharging oil to navigable waterways. The act requires that facilities posing a substantial threat of harm to the environment prepare and implement more rigorous Spill Prevention Control and Countermeasure Plan required under the CWA (40 CFR §112.7). Standards have been set for tank equipment, spill prevention control plans, and vessels. An important requirement affecting refining facilities is oil response plans for above ground storage tank facilities. There are also criminal and civil penalties for deliberate or negligent spills of oil. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and facility response plans to oil discharges (40 CFR Part 112) are being revised and finalized in 1995.¹⁰²

OSHA Health Standards and Process Safety Management Rules

The Occupational Safety and Health Administration (OSHA) limits benzene exposure in the workplace at petroleum refineries (29 CFR §1910.1028). Benzene is a common emission of petroleum refining operations. Control strategies may involve substantial process changes and equipment modifications. OSHA has also developed safety management rules requiring refineries to conduct a detailed review of all operational processes to determine workplace risk and injury potential to workers and to define courses of action in the case of emergencies (29 CFR §1910). Industry reports that this regulation may prove to be

relatively costly due to the numerous and complex process units at petroleum refineries.¹⁰³

State Statutes

Some of the most important state regulations affecting the petroleum refining industry are those of the California Air Resource Board (CARB). The CARB Phase II regulations for reformulated gasoline sold in California are more stringent than the federal CAAA. The South Coast Air Quality Management District (SCAQMD) in southern California has an Air Quality Maintenance Plan which aims to reduce emissions of sulfur oxides, nitrogen oxides, particulates and VOCs from stationary sources. For refineries, one of the most important requirements will be an 8 percent reduction in emissions of NO_x by 1996.¹⁰⁴ Refineries must also carry out a comprehensive leak identification, maintenance, and inspection program. VOC emissions from sumps, wastewater systems and sewers are also limited, and any emission increases must be offset by emission decreases within the facility. Certain refineries must conduct analyses for carcinogenic risks to neighboring populations, and new units or facility modifications cannot exceed specified limits for increased specified cancer risk to individuals in the surrounding community. Industry representatives reported that substantial emission controls and changes in facility operations would be needed to meet the SCAQMD requirements.¹⁰⁵

Refineries are also affected by some state statutes that designate waste oils as hazardous waste. In some states, such as California, any oily waste or waste oil generated in a refinery process must be handled as a RCRA hazardous waste.

VI.C. Pending and Proposed Regulatory Requirements

Energy Policy Act of 1992

The Energy Policy Act of 1992 provided for a number of programs aimed at reducing the U.S. dependence on foreign oil through increased domestic oil production, the use of alternative fuels, and increases in energy efficiency. Some programs established by the Energy Policy Act may have significant effects on the petroleum refining industry in the long term.

The Energy Policy Act mandates the phase-in of alternative fuels in government and private automobile and truck fleets. A national goal for 2010 has been set for 30 percent of the light-duty vehicle market to be powered by natural gas, electricity, methanol, ethanol, or coal-derived liquid fuels. The Act also requires that efficiency standards be set for all new federal buildings, buildings with federally backed mortgages, and

commercial and industrial equipment. Research and development programs are being sponsored for high-efficiency engines and superconducting electric power systems. The effects of these programs will ultimately reduce the growth rate of demand for refined petroleum products in the U.S.¹⁰⁶

Clean Water Act (CWA)

Effluent limitations guidelines for wastewater discharge from petroleum refineries are currently being reviewed by the Office of Water for possible updating in 1995 (Ronald Kirby, U.S. EPA Office of Water, (202)-260-7168). Specifically, the Office of Water is evaluating the need to reduce selenium releases which, in the past, have exceeded water quality standards. Selenium releases are usually only found in facilities processing California crude oil. Effluent guidelines for selenium will, therefore, probably only affect these facilities.¹⁰⁷

Clean Air Act Amendments 1990 (CAAA)

Most of the programs of the CAAA are being phased-in over a period of ten years between 1990 and 2000. Some of the requirements of the CAAA have not yet been set and, as mentioned above, there is a great deal of uncertainty as to the effects that these unspecified standards will have on the industry. The Reformulated Gasoline Program and the NESHAP standards may have the most significant future requirements on the industry. Under the Reformulated Gasoline Program, a "complex" formula for reformulated gasoline is scheduled to go into effect in 1998. The standards for this formula were not yet finalized as of June 1995. It is not known how many other nonattainment areas will eventually "opt in," thereby creating more demand for reformulated gasoline. Several nonattainment areas have already sought to "opt out" of the program.¹⁰⁸

The NESHAP standards are scheduled to be promulgated by EPA by late July 1995 (James Durham, U.S. EPA, Office of Air, (919) 541-5672). The standards required will be in the form of MACT standards. The NESHAP standards will likely be similar to those developed for the chemical industry and will cover air emissions from many refinery processes including, but not limited to, most catalytic processes, industrial boilers, process heaters, storage tanks and equipment, process vents, and wastewater treatment facilities. The standards for the control of benzene emissions will require significant capital investments.¹⁰⁹

Under Title V of the CAAA 1990 (40 CFR Parts 70-72) all of the applicable requirements of the Amendments are integrated into one federal renewable operating permit. Facilities defined as "major sources" under the Act must apply for permits within one year from when EPA approves the state permit programs. Since most state programs were not approved until after November 1994, Title V permits will, for the most part, begin to be due in late 1995. A facility is designated as a major source if it includes sources subject to the NSPS acid rain provisions or NESHAPS, or if it releases a certain amount of any one of the CAAA regulated pollutants (SO_x, NO_x, CO, VOC, PM₁₀, hazardous air pollutants, extremely hazardous substances, ozone depleting substances, and pollutants covered by NSPSs) depending on the region's air quality category. Although revisions to the definition of what constitutes a major source were being negotiated at the time that this document went to press (August 1995), it is important to note that major source determination will likely be based on a facility's potential emissions and not its actual emissions. These revisions to the Title V rules were expected to be published in late August 1995. Title V permits may set limits on the amounts of pollutant emissions; require emissions monitoring, and record keeping and reporting. Under a separate rule, the Continuous Air Monitoring Rule

(CAM) being developed, continuous monitoring of certain emissions from certain facilities may be required (Peter Westlin, U.S. EPA, Office of Air, (919) 541-1058). Facilities are required to pay a fee for filing for a permit and are required to pay an annual fee based on the magnitude of the facility's potential emissions.¹¹⁰

Resource Conservation and Recovery Act (RCRA)

EPA is studying fourteen refinery theoretical waste streams for potential additions to the RCRA hazardous waste lists under a settlement agreement with the Environmental Defense Fund (Maximo Diaz, Jr., Office of Solid Waste and Emergency Response, (202)-260-4786). A decision is to be made on each stream by October 31, 1996. Treatment standards under the Land Disposal Restrictions program will be developed for any wastes listed. Alternatives to listing are also being considered, including management standards based on pollution prevention, recycling, reclamation, or feedstock to other manufacturing processes.¹¹¹

In 1994, a Refinery Workgroup comprised of representatives from OSWER, Office of Water, and Office of Regulatory Council reviewed the issues surrounding a RCRA/CWA interface pertaining to contaminated ground water seeps to surface water from petroleum refineries. The legal authorities over seeps still remains unclear. In a report completed in September 1994, the Workgroup recommended that the legal authority pertaining to seeps to surface waters should be made on a case-by-case basis. The report also discussed the various authorities and circumstances in which they should be utilized.

